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Numerical method for calculation of the generalized natural modes of an inhomogeneous optical fiber

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Abstract

The eigenvalue problem for generalized natural modes of an inhomogeneous optical fiber without a sharp boundary is formulated as a problem for the set of time-harmonic Maxwell equations with Reichardt condition at infinity in the cross-sectional plane. The generalized eigenvalues of this problem are the complex propagation constants on a logarithmic Reimann surface. The original problem is reduced to a nonlinear spectral problem with Fredholm integral operator. Theorem on spectrum localization is proved, and then it is proved that the set of all eigenvalues of the original problem can only be a set of isolated points on the Reimann surface, ant it also proved that each eigenvalue depends continuously on the frequency and refraction index and can appear and disappear only at the boundary of the Reimann surface. The Galerkin method for numerical calculation of the generalized natural modes is proposed, and the convergence of the method is proved.

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